

$$\begin{array}{c}
 \text{H} = \boxed{\begin{array}{ccccccccc}
 1 & 1 & 1 & 1 & 0 & 1 & 1 & 0 & 0 \\
 0 & 0 & 1 & 1 & 1 & 0 & 1 & 1 & 0 \\
 0 & 1 & 0 & 1 & 0 & 1 & 0 & 1 & 1 \\
 1 & 0 & 1 & 0 & 1 & 1 & 0 & 1 & 1 \\
 1 & 1 & 0 & 0 & 1 & 0 & 1 & 0 & 1
 \end{array}}
 \end{array}
 \quad
 \begin{array}{c}
 X = \boxed{\begin{array}{c}
 X_1 \\
 X_2 \\
 X_3 \\
 X_4 \\
 X_5 \\
 X_6 \\
 X_7 \\
 X_8 \\
 X_9 \\
 X_{10}
 \end{array}}
 \end{array}
 \quad
 \begin{array}{c}
 \text{202} \quad \text{206} \quad \text{208} \\
 \curvearrowleft \quad \curvearrowleft \quad \curvearrowleft \\
 \begin{array}{cccccccccc}
 1_1 & 1_4 & 1_7 & 1_{10} & 0 & 1_{16} & 1_9 & 0 & 0 & 0 \\
 0 & 0 & 1_8 & 1_{11} & 1_{13} & 0 & 1_{20} & 1_{22} & 0 & 1_{28} \\
 0 & 1_5 & 0 & 1_{12} & 0 & 1_{17} & 0 & 1_{23} & 1_{25} & 1_{29} \\
 1_2 & 0 & 1_9 & 0 & 1_{14} & 1_{18} & 0 & 1_{24} & 1_{26} & 0 \\
 1_3 & 1_6 & 0 & 0 & 1_{15} & 0 & 1_{21} & 0 & 1_{27} & 1_{30}
 \end{array}
 \end{array}
 \quad
 \begin{array}{c}
 \text{210} \\
 \curvearrowleft \\
 \begin{array}{cccccccccc}
 1_1 & 1_2 & 1_3 & 1_4 & 0 & 1_5 & 1_6 & 0 & 0 & 0 \\
 0 & 0 & 1_7 & 1_8 & 1_9 & 0 & 1_{10} & 1_{11} & 0 & 1_{22} \\
 0 & 1_{13} & 0 & 1_{14} & 0 & 1_{15} & 0 & 1_{16} & 1_{17} & 1_{18} \\
 1_{19} & 0 & 1_{20} & 0 & 1_{21} & 1_{22} & 0 & 1_{23} & 1_{24} & 0 \\
 1_{25} & 1_{26} & 0 & 0 & 1_{27} & 0 & 1_{28} & 0 & 1_{29} & 1_{30}
 \end{array}
 \end{array}$$

Figure 2

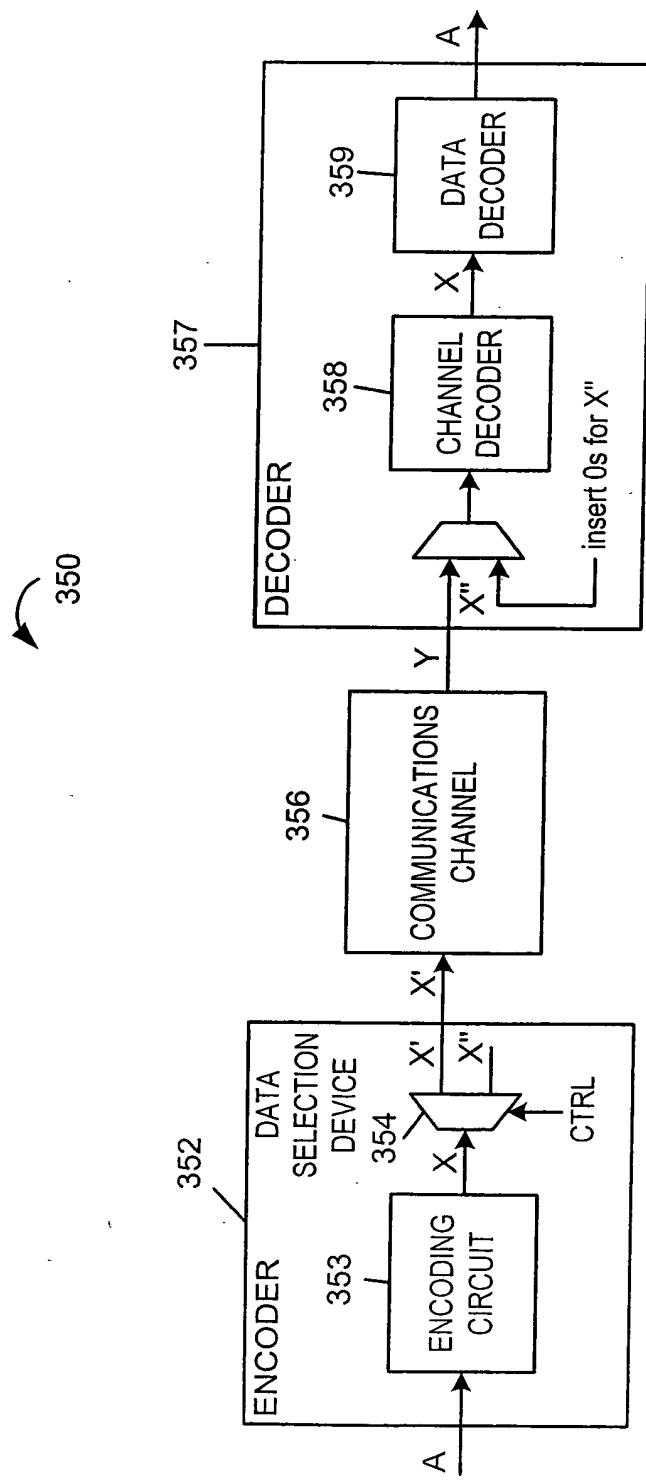


Fig. 3

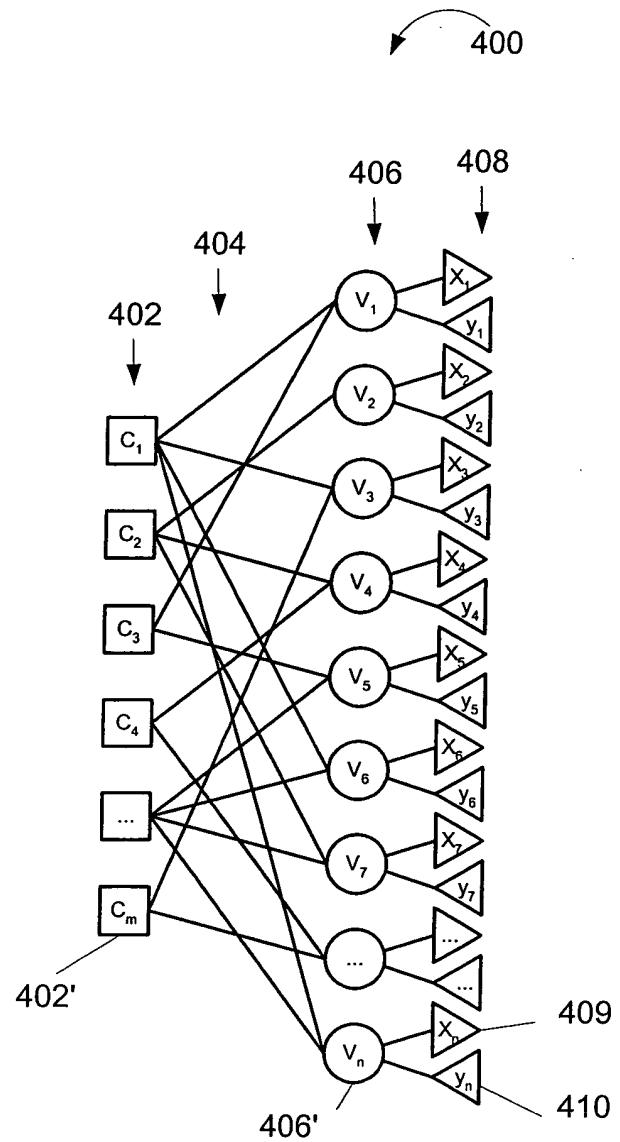


Figure 4

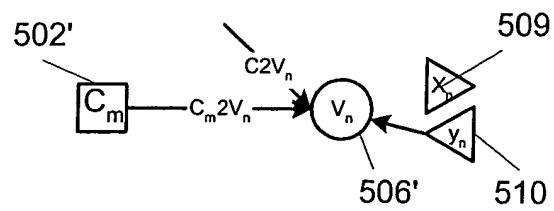


Figure 5a

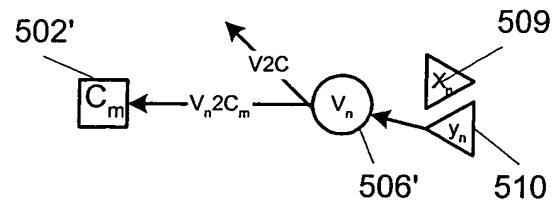


Figure 5b

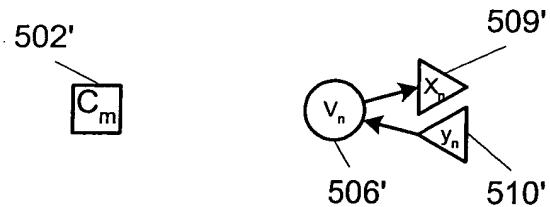


Figure 5c

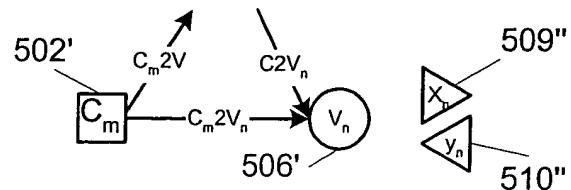


Figure 5d

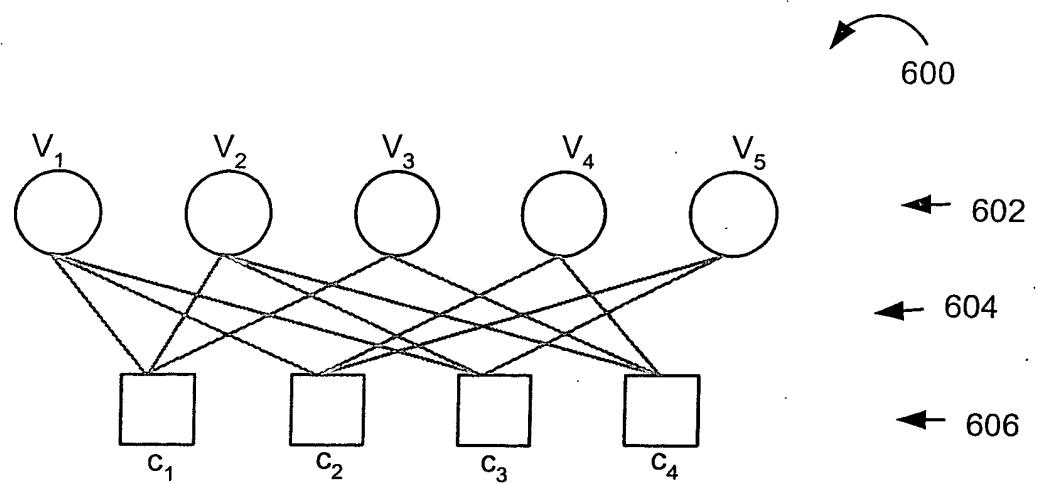


Figure 6

$$H = \begin{bmatrix} 1 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \end{bmatrix} \quad x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix} \quad \begin{matrix} 702 \\ 704 \\ 706 \\ 708 \end{matrix}$$

$$\begin{bmatrix} 1_1 & 1_4 & 1_7 & 0 & 0 \\ 1_2 & 0 & 0 & 1_9 & 1_{11} \\ 1_3 & 1_5 & 0 & 0 & 1_{12} \\ 0 & 1_6 & 1_8 & 1_{10} & 0 \end{bmatrix}$$

$$\begin{bmatrix} 1_1 & 1_2 & 1_3 & 0 & 0 \\ 1_4 & 0 & 0 & 1_5 & 1_6 \\ 1_7 & 1_8 & 0 & 0 & 1_9 \\ 0 & 1_{10} & 1_{11} & 1_{12} & 0 \end{bmatrix}$$

Figure 7

V_1	V_2	V_3	V_4	V_5	$\leftarrow 802$
1	2	3	4	5	$\leftarrow 804$
6	7	8	9	10	
11	12				
c_1	c_2	c_3	c_4		$\leftarrow 806$
1	4	7	2	9	$\leftarrow 804'$
11	3	5	12	6	
10			8	10	

Edge permutation representation - edges enumerated from variable node side.

Figure 8

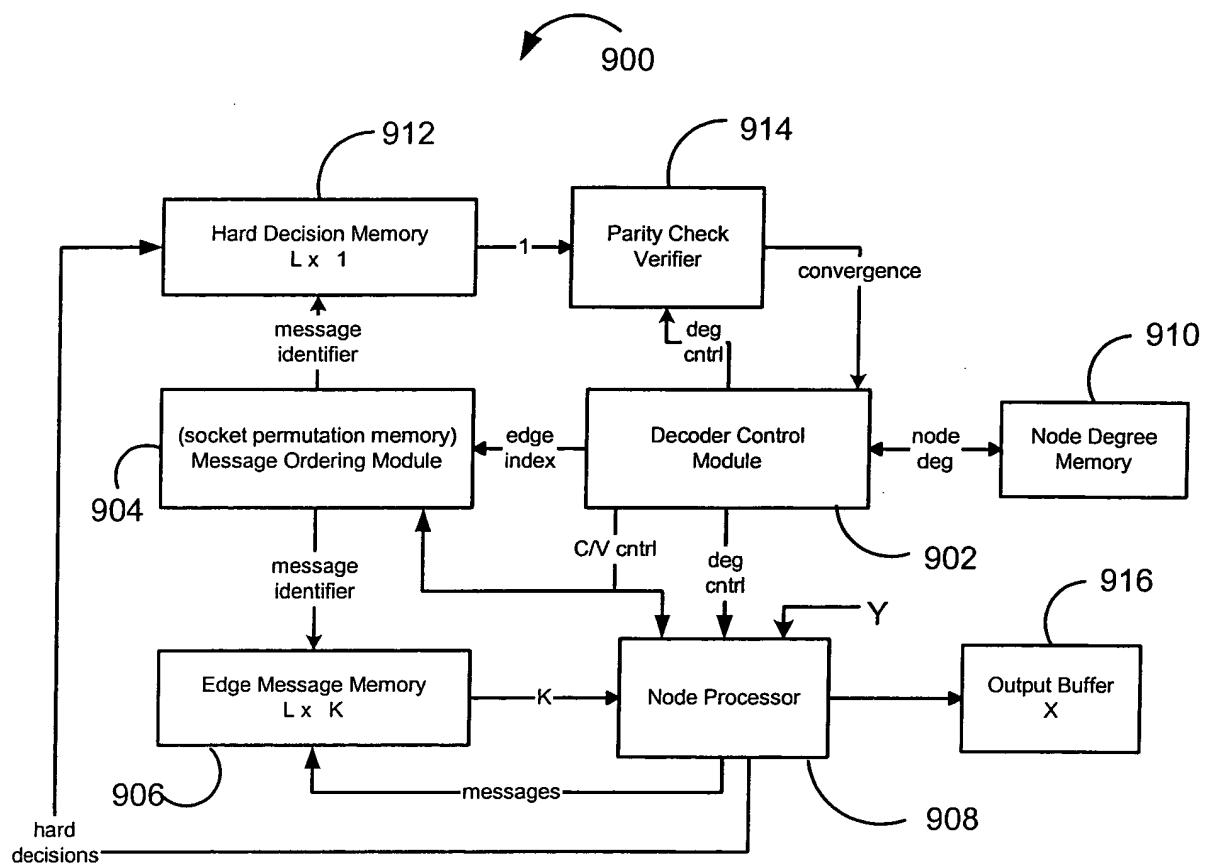


Figure 9

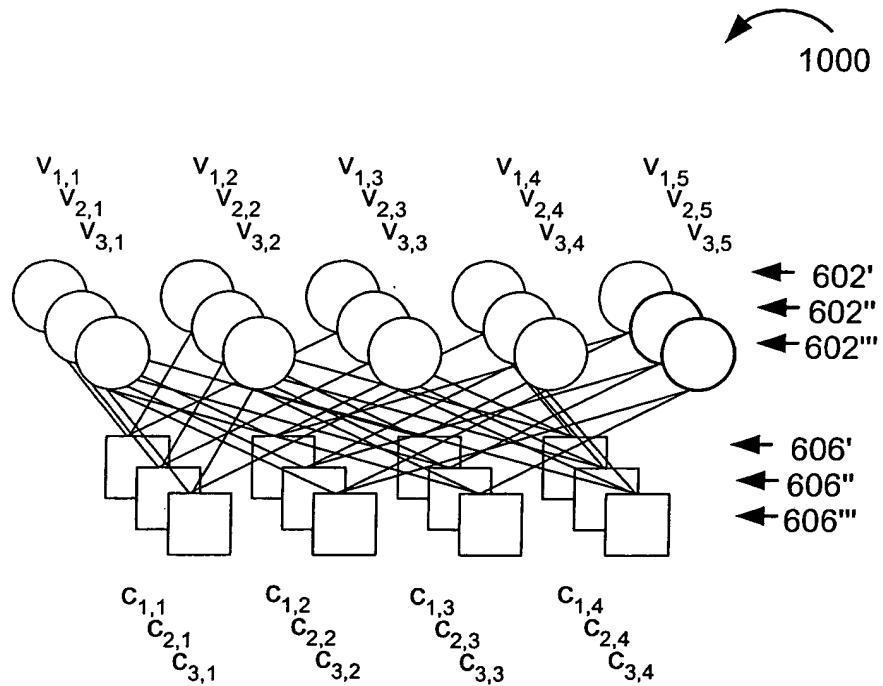


Figure 10

$$H = \left[\begin{array}{ccc|ccc|ccc|ccc|ccc} 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \hline 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 \\ \hline 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ \hline 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \end{array} \right]$$

1102 1104

$x = \begin{bmatrix} x_{1,1} \\ x_{2,1} \\ x_{3,1} \\ x_{1,2} \\ x_{2,2} \\ x_{3,2} \\ x_{1,3} \\ x_{2,3} \\ x_{3,3} \\ x_{1,4} \\ x_{2,4} \\ x_{3,4} \\ x_{1,5} \\ x_{2,5} \\ x_{3,5} \end{bmatrix}$

Figure 11

	v ₁		v ₂		v ₃		v ₄		v ₅			
v ₁	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12
v ₂	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12
v ₃	3,1	3,2	3,3	3,4	3,5	3,6	3,7	3,8	3,9	3,10	3,11	3,12

	c ₁			c ₂			c ₃			c ₄		
c ₁	1,1	1,4	1,7	1,2	1,9	1,11	1,3	1,5	1,12	1,6	1,8	1,10
c ₂	2,1	2,4	2,7	2,2	2,9	2,11	2,3	2,5	2,12	2,6	2,8	2,10
c ₃	3,1	3,4	3,7	3,2	3,9	3,11	3,3	3,5	3,12	3,6	3,8	3,10

Figure 12

1302

$H = \left[\begin{array}{ccc|ccc|ccc|ccc|ccc} 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \hline 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 1 & 0 \\ \hline 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\ \hline 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{array} \right]$

Figure 13

	x ₁			x ₂			x ₃			x ₄			x ₅		
x ₁	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	1,10	1,11	1,12			
x ₂	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8	2,9	2,10	2,11	2,12			
x ₃	3,1	3,2	3,3	3,4	3,5	3,6	3,7	3,8	3,9	3,10	3,11	3,12			

← 1402'
← 1402"
← 1402'''

	c ₁			c ₂			c ₃			c ₄				
c ₁	2,1	2,4	3,7	3,2	1,9	1,11	1,3	3,5	2,12	1,6	2,8	3,10		
c ₂	3,1	3,4	1,7	1,2	2,9	2,11	2,3	1,5	3,12	2,6	3,8	1,10		
c ₃	1,1	1,4	2,7	2,2	3,9	3,11	3,3	2,5	1,12	3,6	1,8	2,10		

← 1404'
← 1404"
← 1404'''

Figure 14

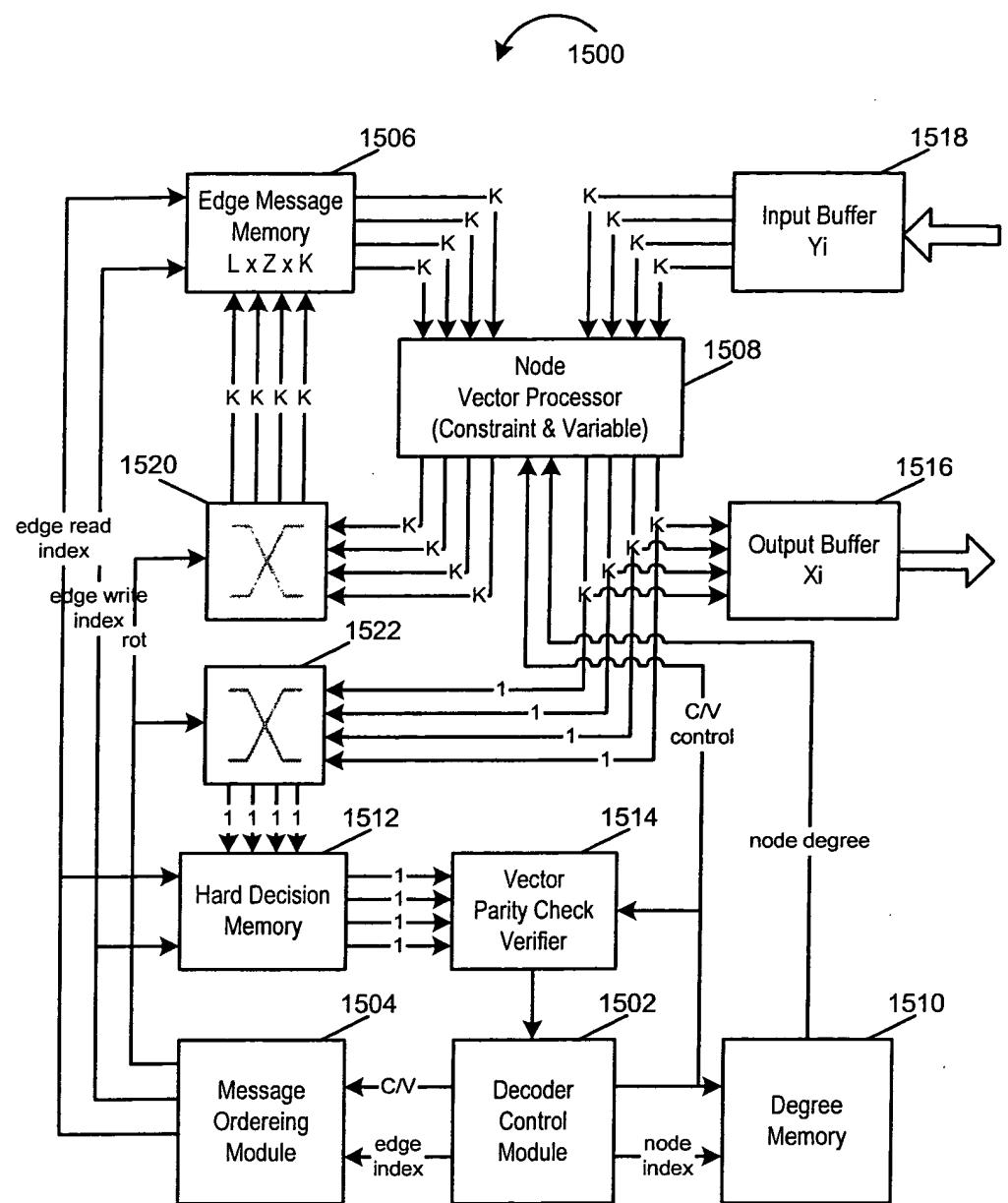


Figure 15

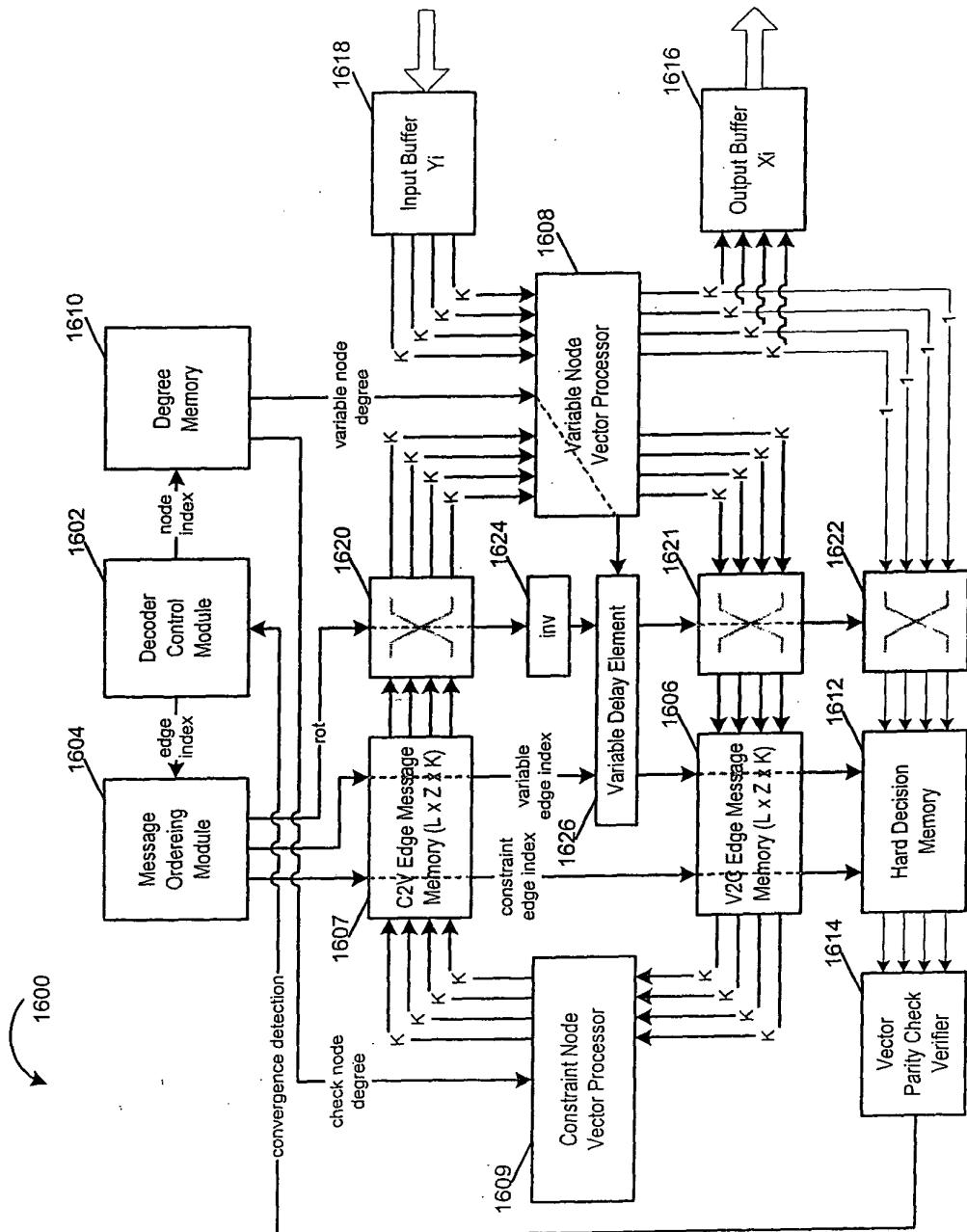


Figure 16

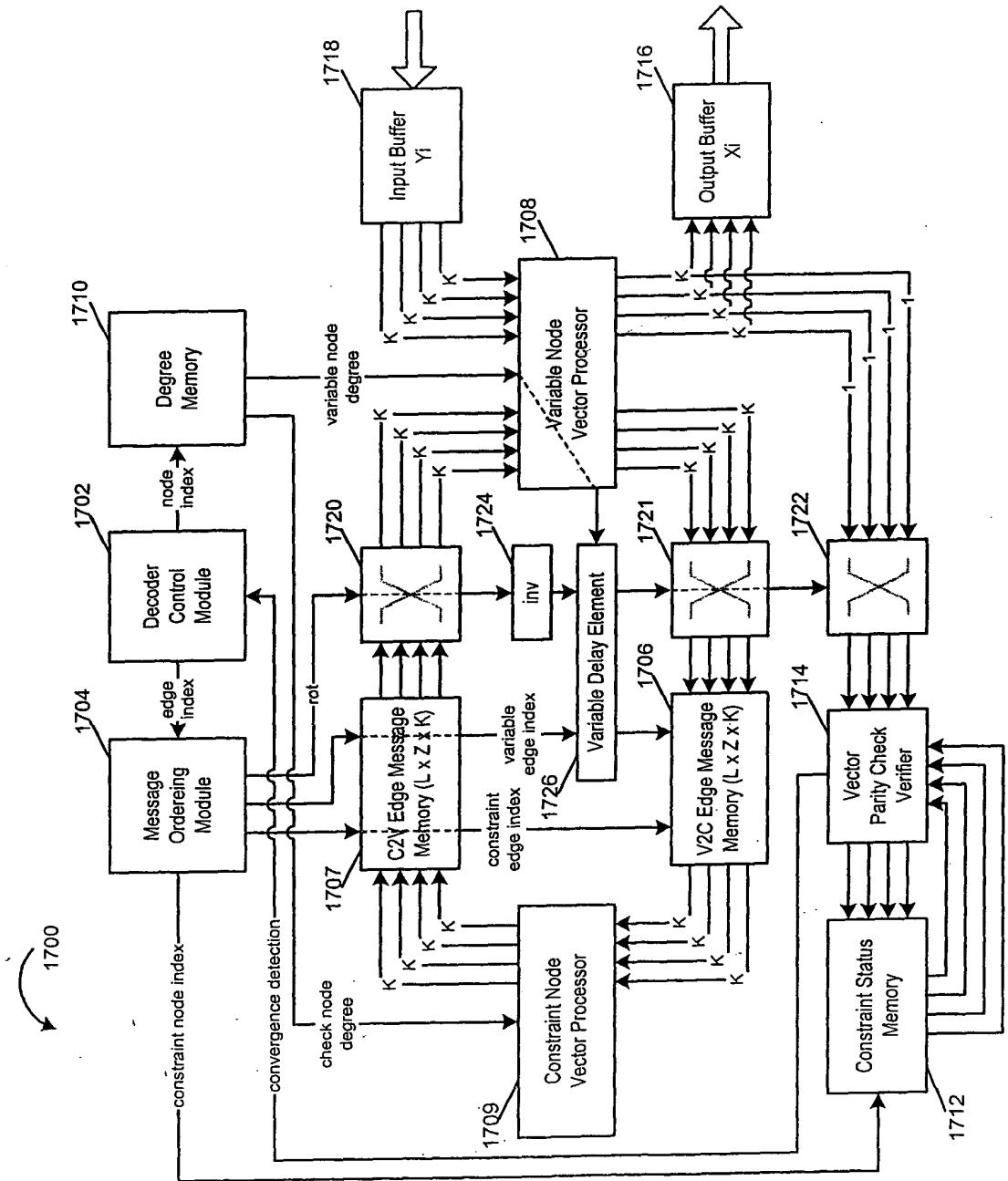


Figure 17